(19) South Korea Patents Administration (KR)
(12)public patent public information (A)

(51) 。 Int. Cl. 7
D01F 8/14

(11) Publication Number: Patent2002-0007569

(43) Publication Date: January 29, 2002

(21) Application Number: 10-2000-0040925

(22) Application Date; July18th, 2000

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Inspection Request: No

(54)) Name of the invention: Polyester partially oriented yarn and its production methods

Abstract

This invention is about polyester partially oriented yarn (processed at a spinning speed of 4,000 ~ 6,000m/minute) and its method of production. It contains a core and a sheath (that are the second ingredients of an orientation/ crystallinity inhibiting performance) with a high concentration and a low concentration respectively. Thus, it can optimize productivity of polyester partially oriented yarn. Furthermore, it usually does not cause hair or breakage-yarn in the drawing and twisting processes. Therefore, it is considered to possess great post process workability.

Table 2

Index

Sheath Extrusion Coating device, Core Extrusion Coating device, Spinneret pipe, Spinningbeam, Sheath/depth Conjugate spinning pack device, ejection breakage-yarn , a cooling device, focusing/ oiling agent guide, number 1 take-off roller, number 2 take-off roller, winding machine, Filament Sheath, Filament Core, number 2 ingredient polymer

Specification

Brief description of the drawings

Table 1 is the processing instrument diagram of the invention.

Table 2 is an enlarged sectional view of a multi-filament, processed by the invention.

A Detailed Description of the Invention

Object of the invention

The technology of this invention and its technical fields.

The invention is about polyester partially oriented yarn that is processed by a high speed spinning method, and its method of production.
Specifically, it is about polyester partially oriented yarn, with a high residual stretch that is processed under high speed spinning conditions, to optimize productivity and to minimize the occurrence of hair during the twisting process.

In other words, it is about polyester oriented yarn (that contains a second ingredient with advanced post process abilities), and its method of production.

As the demand for polyester partially oriented yarn drastically rises, research and development for stable processing methods are actively being performed. Furthermore, research and development for the processing methods of polyester partially oriented yarn, with an application of high speed spinning methods to achieve expansion of production quantity are actively being performed.

The most recent core research and development is a method of production where the second ingredient polymer of the fraction, is injected into the melt spinning process of a conventional polyester polymer.

The general idea of the method is to make a residual stretch of polyester gray yarn produced under the high speed spinning conditions, and a residual stretch of the polyester gray yarn produced under general low speed spinning conditions, to become similar to each other. Under high speed spinning conditions, the second ingredient polymer coexists between the polyester molecules to restrain the orientation/ crystallinity of polyester molecules.

The method of processing polyester partially oriented yarn by applying high speed spinning methods where the second ingredient polymer is blended and injected, is illustrated in United States of America Patent Number 5,993,712.

Among the methods of spinning processes, this is a processing method of polyester partially oriented yarn that is applied at a high speed spinning method. Under conditions where copolymer, that is created by placing acryl family ingredients, styrene ingredients, and the maleate of fraction through the blending and polymerization process, with a particular ratio, is used as a second ingredient polymer. Furthermore, the second ingredient polymer is fractionally added and equally decentralized to the polyester polymer.

However, the abovementioned processing method creates a situation where each filament surface fraction force and the static characteristic differ, since the second ingredient polymer is decentralized in each filament and the in the sheath of fibers. Also, it is decentralized in the filament surface by the winding guide and the fraction action. Therefore, it creates a problem where the convergence of the filament becomes inconsistent by forming a convex or concave on the filament surface through a dropping of the second ingredient polymer that coexists.

Therefore, the surface characteristic changes and convergence changes in the filament causes a layer break up, or package form defects, after winding. In severe cases, it frequently causes yarn breakage occurrence in the winding process, decreasing the winding workability. As a result, it possesses a disadvantage when the increased productivity effect cannot be achieved through high speed spinning.
Also, the second ingredient needs to possess an applied orientation/crystallinity restraint effect. Thus, the special copolymer is created and used by blending acryl family ingredients, styrene ingredients, and maleate ingredients. Therefore it possesses a disadvantage, due to the factor of extra facility investment (such as a polymerization device that could process the second ingredient polymer).

Also, Japan Patent public Information 99-269.719 illustrates the following method. It is a method where the decentralized concentration of the second ingredient polymer (that is decentralized in the inside of each polyester filament) possesses differences by cross section areas.
In reference to this method, if the radius of the filament is " r" , approximately 50% of the second ingredient polymer is close-packed decentralized in the range of r/3 ~ 2r/3. The other 50% coexists in the sheath and core parts of the filament.

However, the decentralized concentration of second ingredient polymer in the fiber sheath decreases with this method. Thus, it could minimize the surface characteristic changes due to the decentralization of the second ingredient polymer in the filament surface. But, it cannot provide an adequate orientation/crystallinity restraint effect of polyester molecular substance in the core, at the time of high spinning process, due to the low concentration of second ingredient polymer in the core.

Therefore, polyester partially oriented yarn processed by high speed spinning methods, in the abovementioned method, does not possess an adequate residual stretch. Thus, it possesses the disadvantages of a low productivity improvement effect. Furthermore, it possesses difficulties where a conventional polyester spinning device cannot be applied, due to the fact that it is very hard to perform concentrated decentralization of the second ingredient in a particular area of each filament.

Accomplishment of invention of technical subject

The invention can make the residual stretch of polyester partially oriented yarn processed through a high speed spinning process, to become similar to the residual stretch of a conventional partially oriented yarn processed through low speed spinning processes. Thus, it can maximize the increased effect of production quantity due to the high speed spinning processes. Furthermore, it minimizes the property and characteristic differences between each filament of the processed partially oriented yarn. Therefore,

there is almost no occurrence of hair, or breakage of yarn, in the twisting process. The purpose of the invention is to provide a processing method that enables the processing of the polyester partially oriented yarn with excellent post process workability, by the abovementioned methods.

Configuration and processing of the invention

The following illustrates the invention in specific details through example drawings.

Table 1, is the processing procedures table of the invention. Table 2 is the expanded sectional view of the partially oriented yarn, processed through the invention.

As it is illustrated in Table 1. By compressing the polymer that composes the sheath (I), and the polymer that composes the core (II), through applying the sheath extrusion coating device (1), and core extrusion coating device (2), the polyester yarn that contains the second ingredient (spinning beam (4)and sheath/depth conjugate spinning pack device (5), is placed through the melt spinning process, through spinneret pipe (3).

The abovementioned ejection breakage (6) is frozen and solidified by the conventional method of using a cooling/freezing device (7). Then it is placed under the focused and Emulsion processed in the focused/Emulsion guide (8). After that, the polyester partially oriented yarn (POY) is processed by partially drawing between the number 1 take-off roller(9) and number 2 take-off roller(10) and winding in the winding device (11) at a winding speed of 4,000 ~ 6,000 m/minutes.

The second ingredient polymer (B) is conventionally Immiscible with the polyester. However, the glass transition temperature is higher than the glass transition temperature of conventional polyester, and lower than the crystallinity temperature. Applied second ingredient polymer (B) is the Amorphous polymer that possesses a low thermal characteristic as explained above.

Specifically, the thermoplastic polymer (such as polymethylmethacrylates family polymer,polystyrene family polymer, andpolycarbonate etc) that possesses the characteristic where the glass transition temperature is above 80℃, and below 120℃.

At this time, the conventional spinning pack device (5), of multi-sheath/depth structure is used at the formation of the sheath/depth cross section (where there are differences in the concentration of the second ingredient polymer (B), in each filament) to make them equal.

The second ingredient polymer blend concentration of processed partially oriented yarn possesses a lower concentration than the surface layer (I) of the filament and higher concentration than the inside core (II), in reference to the filament cross section area.

In reference to the invention, the compound ratio for the blend concentration and sheath/depth of the second ingredient polymer in each area of the sheath/core is very important to achieve the residual stretch of the partially oriented yarn and spinning/winding workability. It is explained in more specific detail as follows.
First of all, when the blended concentration of the second ingredient polymer (B) mixed in the sheath (I) becomes more than a certain amount by the effects of the blend concentration, a decrease of the spinning/winding workability occurs through the surface characteristic changes of the filament. When it becomes too low, a great difference between the core (II), and the orientation/crystallinity occurs. And it creates surface damages and the occurrence of gaps in the surface of the fiber. Therefore, there is a disadvantage in reducing the manufacturing workability of the drawing twisting (D/T) and decreasing the strength of the partially oriented yarn.

On the other hand, the effects of the blend concentration in the core (II) are often closely related to the residual stretch and strength of partially oriented yarn. When the concentration at the core (II) is too low, the orientation/crystallinity restraint effect of the polyester molecular substance becomes minimal. Thus, it creates a disadvantage by reducing the residual stretch occurrence. When the concentration becomes too high, the occurrence of residual stretch is excellent. However, it reduces the strength of the processed gray yarn and weakens the post process workability.

Also, in reference to the compound ratio of the sheath (I) and core (II), when the ratio of the sheath (II) is too high, in other words, when the ratio of core (II) is too low, the role of the core (that possesses the high orientation/crystallinity restraint of the processed polyester partially oriented yarn) decreases. Furthermore, it causes a decrease in the residual stretch of the processed polyester partially oriented yarn.
Therefore it possesses a disadvantage where the improvement of productivity is reduced due to high speed spinning.
In the case where the ratio of the sheath (I) is too low, in other words, when the compositional ratio of the core (II) is too high, the structural formation of the sheath/depth becomes unstable. And it results in a cross section formation of each filament becoming non-uniformed.
Furthermore, it results in non-uniformity of the properties and characteristics of processed gray yarn.

In reference to the invention, in order to process polyester partially processed yarn that possesses a residual stretch above 100% at a spinning speed of 4,000 ~ 6,000 m/minutes.

The following conditions need to be achieved. In reference to the blend concentration of the second ingredient polymer at sheath (I) and core (II), and the compound ratio of sheath/core at cross section, and the injection of the proper amount of second ingredient polymer from the perspective of polyester polymer

Following:

1) Blend concentration of second ingredient polymer at each area.
- Sheath: more than 0.1 amount %, less than 0.5 amount % ratio in reference to polyester polymer
- Core: more than 0.4 amount %, less than 2.0 amount % ratio in reference to polyester polymer

2) Sheath/Core compound ratio
- Sheath: more than 10 % and less than 30 % in reference to the total area of the fiber.
- Core: more than 70 % and less than 90 % in reference to the total area of the fiber.

By applying the processing technique made for conventional compounds yarn of sheath/depth structure, and applying the method where the second ingredient, that possesses the effect of restraining the orientation/crystallinity of the polyester molecular substance in the spinning procedural step of the polyester, is blend injected into the sheath (I) and core (II) with a certain ratio. The invention obtains polyester partially oriented yarn with the residual stretch of 100 ~ 180 % and more than 2.5g/denier of strength at the spinning at 4,000m/minute ~ 6,000m/minute.

The abovementioned partially oriented yarn can be processed as drawing twisting yarn (DTY) without creating hair and breakage yarn through the drawing/twisting process at yarn speed 800 ~ 1,200 m/minute, and drawing at a drawing ratio of 1.3 ~ 2.4.

The processed drawing twisting yarn possesses excellent strength and stretch. Furthermore, it possesses a excellent post process characteristic in reference to the weaving/dyeing.

Execution Example 1 ~ 5

The conventional polyester polymerization substance with a Inherent Viscosity(IV) of 0.64 is used as a standard. By applying the spinning device shown in Table 1, polyester

partially oriented yarn is processed at a spinning temperature of 285℃, and spinning speed of 5,000m/minute.

At this time, the second ingredient polymer is blended and injected with polyester material, in the material injecting place, of the sheath extrusion coating device (1), and the core extrusion coating device (2).
The conditions for the compound ratio of the sheath, core, and the blend concentration of the second ingredient polymer in reference to the areas of the sheath/core are illustrated in Table 1.

For the second ingredient polymer,polymethylmethaAcrylates of the type name 8N(MI=2.5) from Rohm, Germany is used. And it is controlled to possess Capacity where the finnese of the drawing yarn is 75 denier.
Also, the processed partially oriented yarn is evaluated by a post process workability, such as the drawing workability, the occurrence of hair, etc. by processing with the drawing, twisting yarn (DTY) at spinning speed of 800m/minute, and heater temperature of 190℃.

Comparison Example 1 ~6

Except for the changes in the injected amount of the second ingredient polymer, the changes in the compound ratio of sheath/core, and the changes in the blend concentration of the second ingredient polymer at the sheath/depth, polyester partially oriented yarn is processed with an identical method.

The applied conditions and properties of processed gray yarn are illustrated in Table 2.

< Table 1 >

Item			unit	Execution Example 1	Execution Example 2	Execution Example 3	Execution Example 4	Execution Example 5
Test condition	second ingredient blend concentration	Sheath	Weight %	0.1	0.2	0.2	0.4	0.5
		Core		0.4	0.8	0.8	1.5	2.0
	Compound ratio	Sheath	%	10	20	30	30	30
		Core		90	80	70	70	70
Test results	Partially Oriented Yarn(POY)	breaking strength	g/denier	3.6	3.1	3.3	2.4	1.9
		stretch	%	103.2	121.4	114.9	142.6	173.6
		spinning	---	◎	◎	◎	○	○
	drawing,twisting yarn (DTY)	breaking strength	g/denier	4.9	4.5	4.6	4.4	4.2
		stretch	%	28.4	29.3	30.5	29.1	28.5
		drawing	---	◎	◎	◎	○	○

* The second ingredient blend concentration: the second ingredient polymer injection amount for each area in reference to the polyester polymer amount ratio.

< Table 2 >

Item			unit	Execution Example 1	Execution Example 2	Execution Example 3	Execution Example 4	Execution Example 5	Execution Example 6
Test condition	second ingredient blend concentration	Sheath	Weight%	---	---	0.6	0.1	0.5	0.1
		Core		---	1.0	1.5	0.3	2.5	0.9
	Compound ratio	Sheath	%	50	20	30	10	30	40
		Core		50	80	70	90	70	60
Test results	Partially Oriented Yarn(POY)	breaking strength	g/denier	4.1	2.3	2.3	3.9	1.4	3.6
		stretch	%	64.2	126.3	154.8	89.3	198.4	98.4
		spinning	---	●	○	△	○	△	●
	drawing,twisting yarn (DTY)	breaking strength	g/denier	5.1	3.8	4.1	4.8	3.4	4.6
		stretch	%	28.1	29.5	30.8	31.5	33.1	29.5
		drawing	---	●	△	×	○	×	●

* The second ingredient blend concentration: the second ingredient polymer injection amount for each area, in reference to the polyester polymer amount ratio.

< Evaluation method >

1. Spinning characteristics: In reference to a 24 hour standard, it is evaluated to be excellent (◎) when there is not a yarn breakage occurrence, when there is one yarn breakage occurrence, it is evaluated to be good (○), when there is two yarn breakage

occurrences, it is evaluated to be average (△), when there is more than two occurrences of yarn breakage occurrences, it is evaluated to be poor (×).

2. Drawing characteristic: The DTY is processed under the conditions where the drawing ratio shows a stretch of 30%. It is evaluated to be excellent (◎) when there is not an occurrence of hair, when there is 0.5ea/kg of hair occurrence, it is evaluated to be good (○), when there is 0.6 ~ 1ea/kg of hair occurrence, it is considered to be average (△), when there is 1ea/kg of hair occurrence, it is evaluated to be poor (×).

3. Strength/stretch of the processed gray yarn: Illustrated result is obtained from performing under the conditions where the sample length is 20㎝, tensile speed is 100mm/minute.

Effect of invention

By applying the invention, polyester partially oriented yarn can be processed with a high productivity since poor spinning/winding workability by blend injected second ingredient polymer does not occur. Also, it demonstrates a high residual stretch when the spinning conditions are set to be high.
Furthermore, the strength and characteristic of the processed polyester partially oriented yarn is equally excellent. Also, it does not create hair or yarn breakage in the drawing /twisting procedural steps. Therefore it possesses excellent post process workability.

(57) Claim Scope

Claim 1

In reference to the procedural steps of polyester partially oriented yarn (POY), the second ingredient with the orientation/crystallinity restraint functions of the polyester molecular substance is blended with conventional polyester polymer. Then, it is placed through the process of melt spinning at the spinning speed of 4,000 ~ 6,000 m/minute, and partially drawing process. The one with a larger blend concentration of the second ingredient is considered to be core (core), the one with a smaller blend concentration is considered to be sheath (sheath).
The above is accomplished by applying a sheath/depth conjugated spinning pack device. It is processed through conjugated spinning to possess a residual stretch of 100 ~ 180 %. These are the characteristics of processing methods for polyester partially oriented yarn

Claim 2.

As polyester partially oriented yarn, the core contains the highly concentrated second ingredients that possess the orientation/crystallinity restraint function at conventional polyester polymer.

The sheath (sheath), contains a low concentrated second ingredient of conventional polyester polymer.

It is the polyester partially oriented yarn that is characterized by possessing a much greater area ratio of sheath (sheath) than the area ratio of core (core)

Claim 3.

In reference to the claim 2, the concentration at the core of the second ingredient in reference to polyester polymer is 0.4 ~ 2.0 amount %. The concentration at the sheath is 0.1 ~ 0.5 amount %. These are the characteristics of polyester partially oriented yarn.

Claim 4.

In reference to the claim 2, the area ratio of sheath is 70 ~ 90 %. The area ratio of core is 30 ~ 10 %. These are the characteristics of polyester partially oriented yarn.

Claim 5.

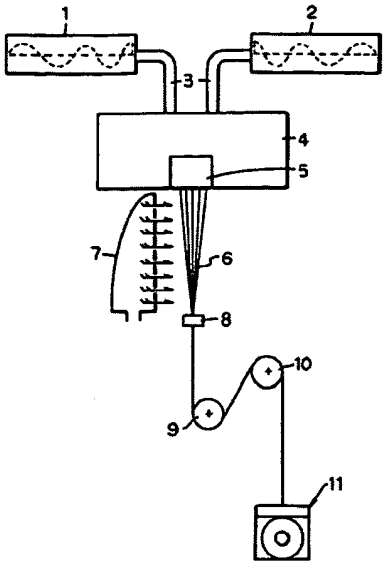
In reference to the claim 2, the second ingredient is Amorphous and is Immiscible towards conventional polyester polymer. Also, it is the thermoplastic polymer with glass transition temperature of 80 ~ 120℃. These are the characteristics of polyester partially oriented yarn.

Claim 6.

In reference to the claim 5, the second ingredient is selected from polymethylmethaAcrylates ,polyStyrene, andpolycarbonate, etc. These are the characteristics of polyester partially oriented yarn.

Drawings

Drawings 1



Drawings 2